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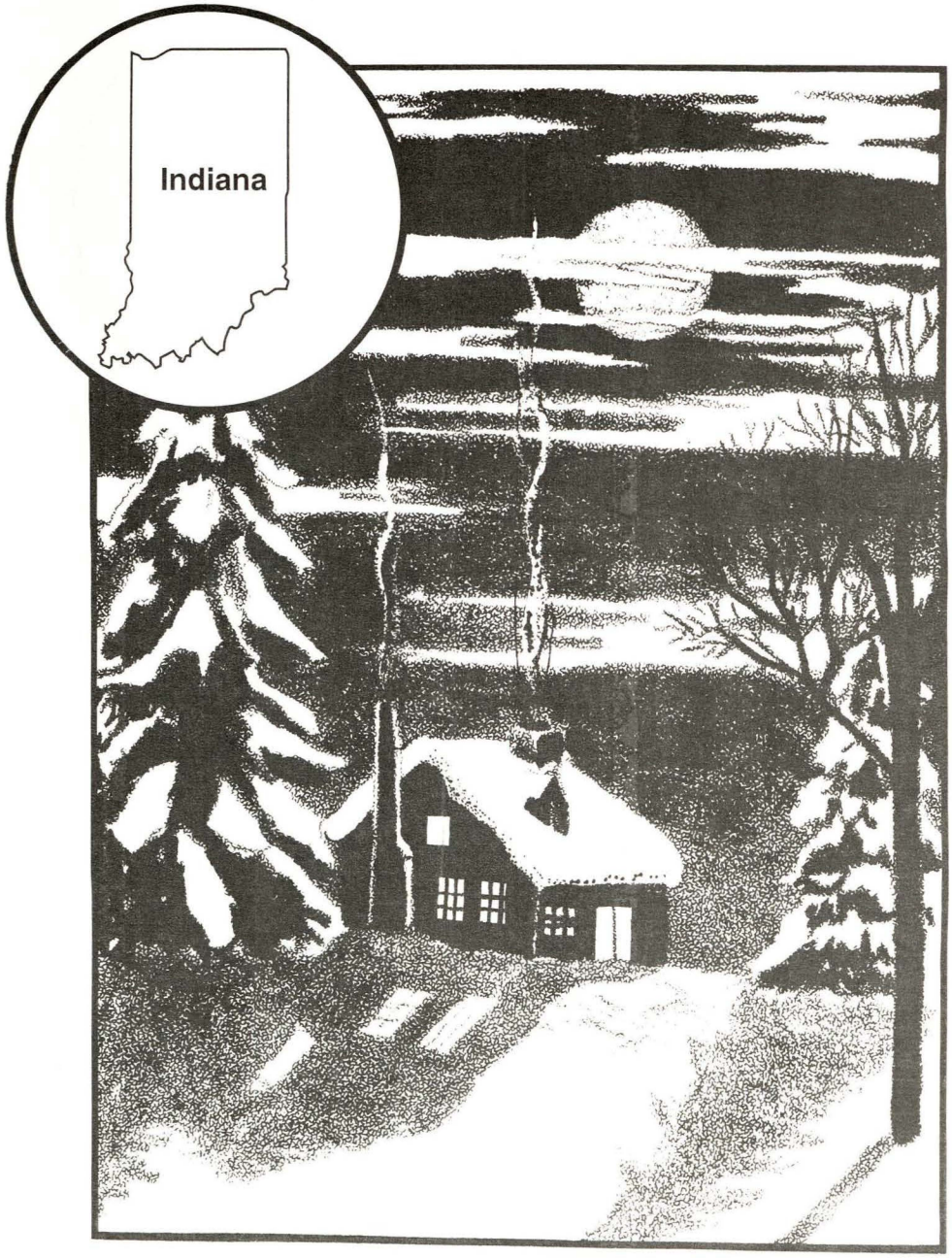
North Central Forest Experiment Station

Resource Bulletin
NC - 188

Residential Fuelwood Consumption and Production in Indiana, 1996

Dennis M. May, Jeff Settle, and Tamara Benjamin



North Central Forest Experiment Station
Forest Service—U.S. Department of Agriculture
1992 Folwell Avenue
St. Paul, Minnesota 55108
Manuscript approved for publication November 4, 1997
1997

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no
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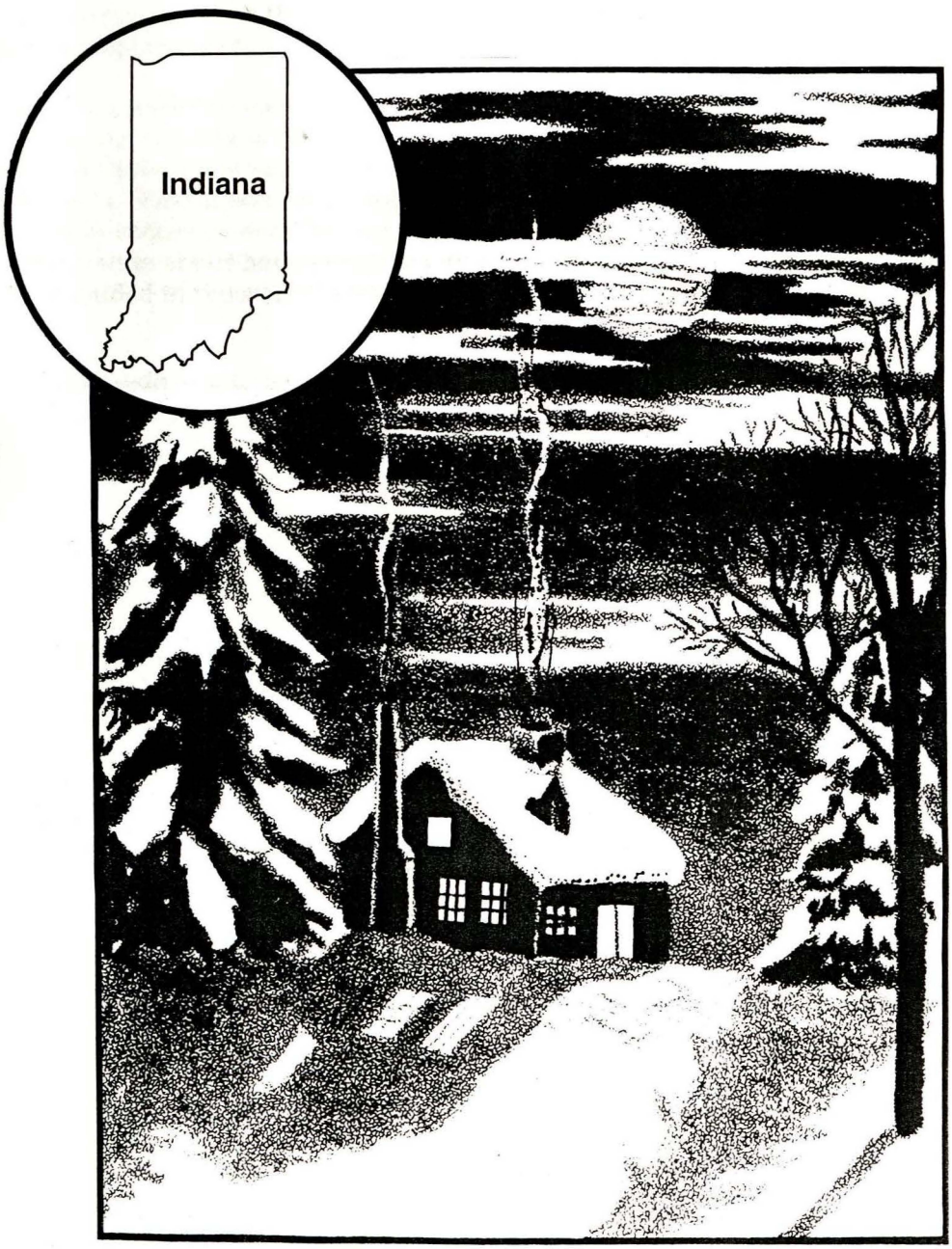

FOREWORD

This bulletin reports the results of a survey of residential fuelwood consumption and production in Indiana for a 1-year period encompassing the 1995/1996 heating season. Topics examined include the geographic distribution of residential fuelwood consumption and production within the State; the species of trees used for residential fuelwood; the types of wood-burning facilities used; the reasons for burning fuelwood; and the land, ownership, and tree classes from which fuelwood was produced. Such detailed information is necessary for intelligent planning and decisionmaking in wood procurement, forest resource management, forest industry development, and forest research.

The survey was conducted in cooperation with the Indiana Department of Natural Resources and was partially funded by the Indiana Biomass Grant Program, which is administered by the Energy Policy Division of the Indiana Department of Commerce. The cooperation of the Indiana households and commercial producers who took the time to respond to this survey is also acknowledged and appreciated.

In this bulletin, consumption refers to the volume of fuelwood burned by Indiana's households, regardless of the source of the fuelwood (roundwood, wood residues from primary or secondary manufacturing, scrap or waste wood products, etc.). Production refers only to the volume of roundwood harvested to supply Indiana's wood-burning households. This report *does not* include information about harvesting for industrial fuelwood. Such information is included in reports covering wood use by primary processing plants.

Row and column data of tables may not sum due to rounding, but data in each table cell are accurately displayed.

CONTENTS

Page

Consumption 1
Production 5
Appendix 6
  Study Methods 6
    Residential Households 6
    Commercial Producers 8
  Sampling Error 8
  Study Limitations 8
  Definition of Terms 9
  Species Groups, Common and Scientific Names of Tree Species Mentioned 11
  Table Titles 12

Residential Fuelwood Consumption and Production in Indiana, 1996

Dennis M. May, Jeff Settle, and Tamara Benjamin

CONSUMPTION

- Three out of 10 Indiana households had facilities to burn wood in 1996, but only two-thirds of them burned wood in that year (table 1).
- As a result, only about one in five households burned wood in 1996; a similar proportion planned to burn wood in 1997.
- In 1996, more than 56,000 households planned to install wood-burning facilities. Seventy percent of the installations will be new, the rest will be replacement or supplemental units for households already burning wood.
- Seventy percent of the households possessing and using wood-burning facilities in 1996 were located in the Northern Survey Unit of the State (table 1 and fig. 1).
- On average, each of Indiana's wood-burning households burned 1.3 cords of fuelwood in 1996, for a total consumption of just over 511 thousand cords (table 2).
- In the more populated Northern Unit, pleasure was the most popular reason for burning wood, while burning wood for home-heating was more prevalent in the other, more rural, Survey Units.
- Overall, pleasure was the most popular reason for burning fuelwood in 1996.
- On average, households that burned wood for pleasure consumed one-third of a cord of fuelwood, only a fraction of the volume consumed by households that heated with wood.
- As a result, more fuelwood was consumed for home-heating than for pleasure in 1996 (table 2 and fig. 2).
- Fireplaces were the most popular type of wood-burning facility used by Indiana households in 1996 (table 3). This was especially true in the Northern Unit where households burned wood primarily for pleasure, while wood stoves were more prevalent in the other, more rural, Units where households burned wood primarily for home-heating.

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Tamara Benjamin, Research Assistant, Department of Forestry and Natural Resources, Purdue University, IN, received her B.A. degree in biology and education from Hamline University, St. Paul, MN, in 1990. From 1991 to 1993, she served as a volunteer in Costa Rica with the U.S. Peace Corps as a forestry extentionist. In 1996 she completed her M.S. in forest economics at Purdue University studying temperate agroforestry. Currently she is studying for her Ph.D. in agroforestry at Purdue University.

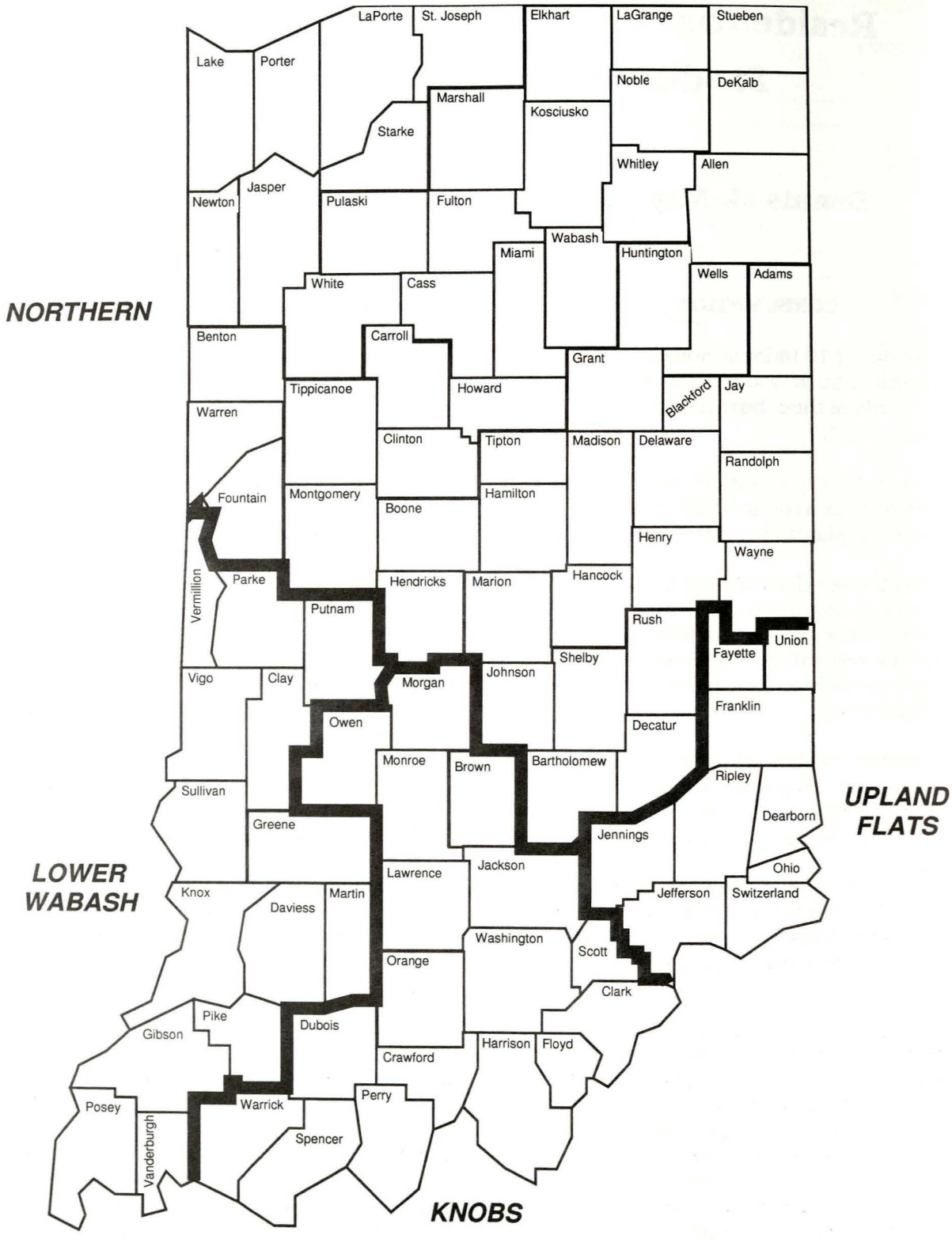

Figure 1.—*Forest Survey Units in Indiana, 1996.*

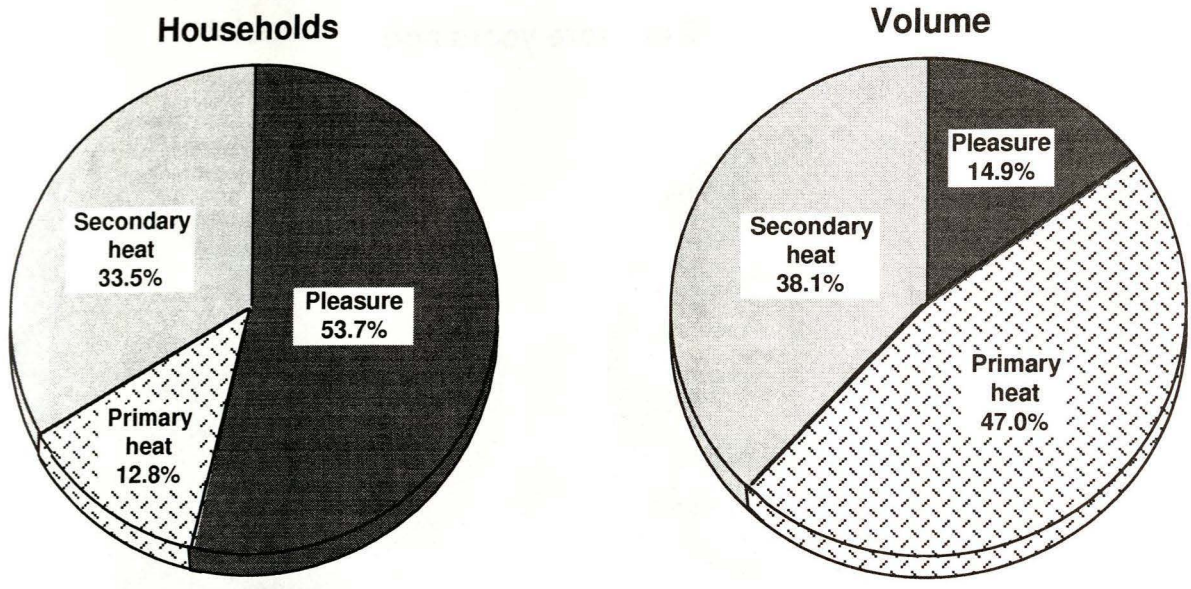

Figure 2.—*Distribution of residential fuelwood consumption by reason for burning, Indiana, 1996.*

- Four-fifths of the households that burned wood in fireplaces did so for pleasure, while about 90 percent of households that burned wood either in wood stoves or furnaces did so for home-heating (table 4).
- As a result, almost two-thirds of all fuelwood consumed in 1996 was burned in either wood stoves or furnaces, much more than was burned in the far more numerous fireplaces (fig. 3).
- In 1996, almost two-thirds of Indiana's wood burners had burned wood for at least 5 years (table 5).
- Compared to their more recent counterparts who burned wood primarily for pleasure (fig. 4), these veteran wood burners were more likely to burn wood for home-heating, and consequently burned 83 percent of all fuelwood consumed in 1996.

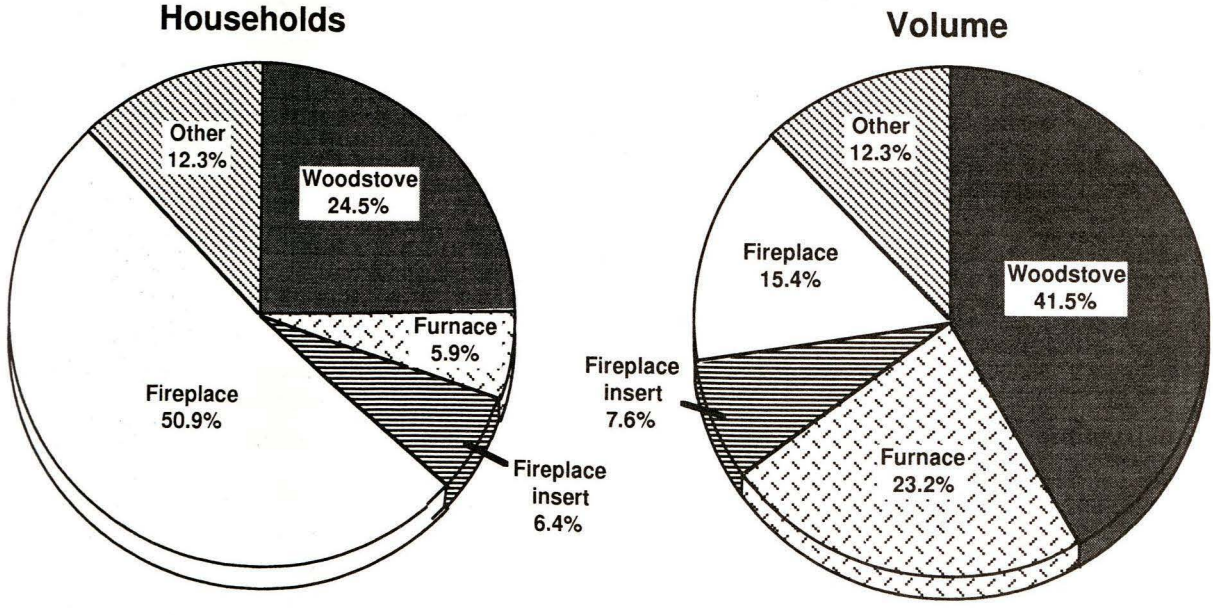

Figure 3.—*Distribution of residential fuelwood consumption by wood-burning facility, Indiana, 1996.*

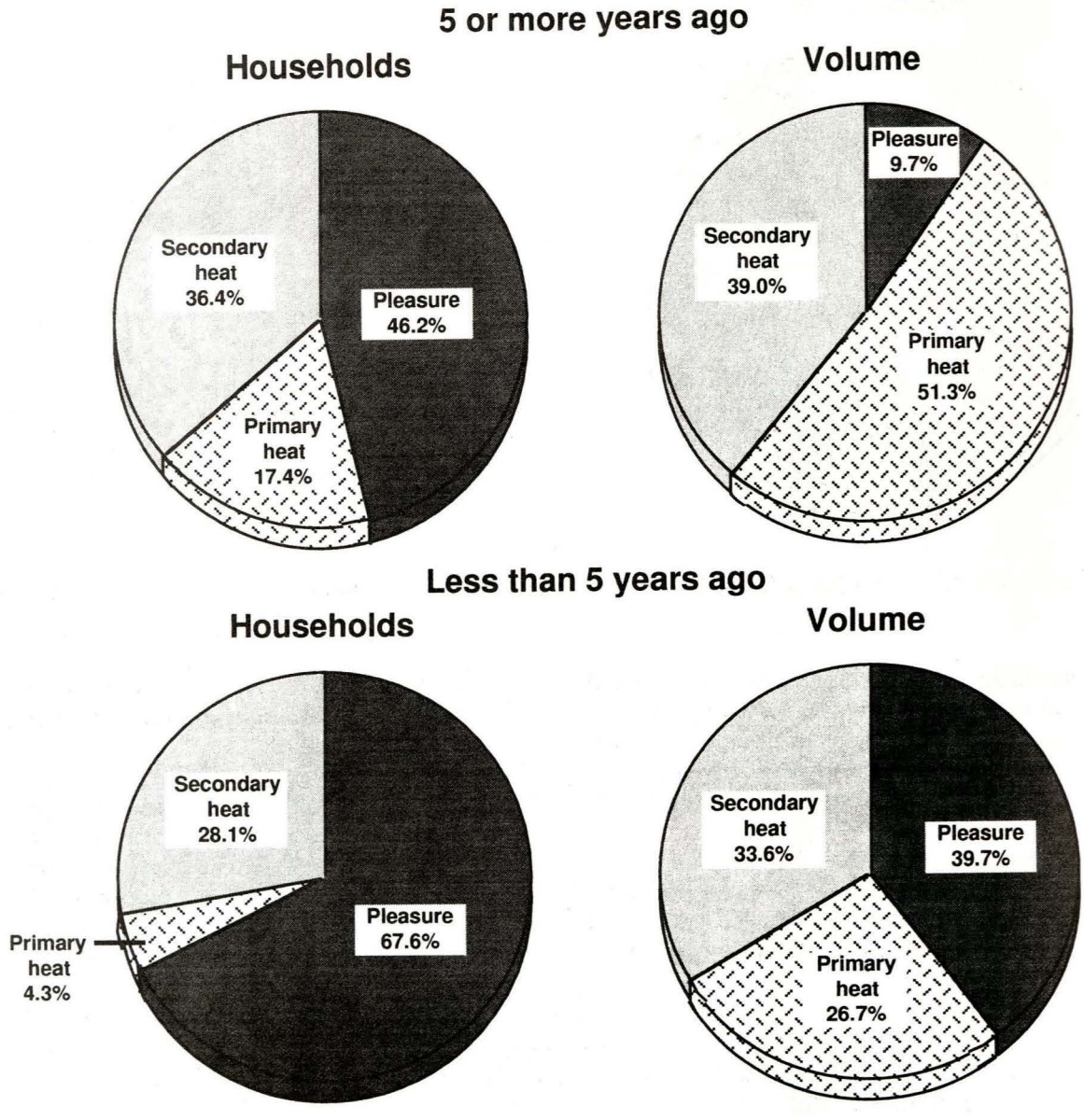

Figure 4.—*Distribution of residential fuelwood consumption by reason for burning and year first burned wood, Indiana, 1996.*

- Almost all (95 percent) of the fuelwood burned in 1996 was consumed at primary residences (table 6).
- Almost all (97 percent) of the fuelwood burned came from roundwood, but about 11 percent of the households relied on wood residues for all or part of their fuelwood needs in 1996 (table 7).
- Three main species—oak, ash, and hickory—accounted for 70 percent of the volume burned; oak alone accounted for two-fifths of the total consumption (table 8).
- Close to two-thirds of Indiana's wood-burning households cut all or part of the fuelwood they burned in 1996 (table 9).
- In total, 71 percent of the volume burned in 1996 was cut by residents of wood-burning households. Most of the remaining volume, 23 percent of total consumption, was purchased (fig. 5).

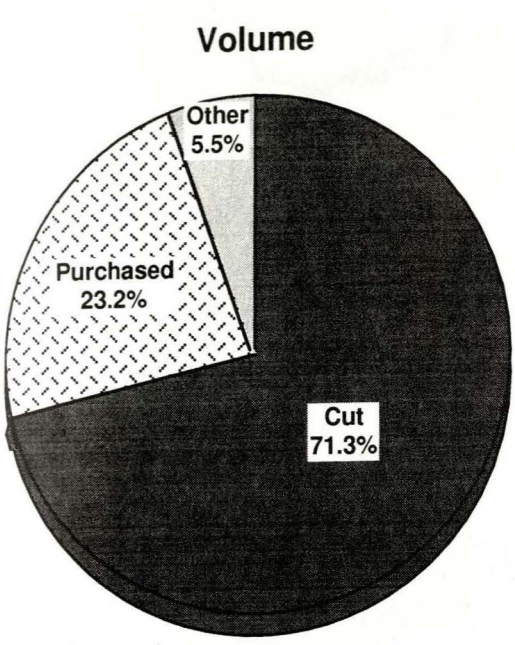

Figure 5.—*Distribution of residential fuelwood consumption by procurement method, Indiana, 1996.*

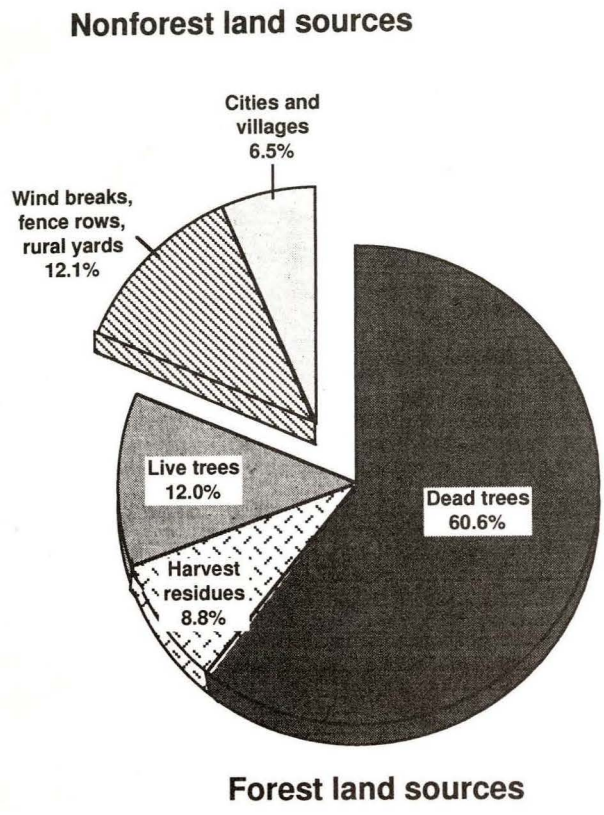

Figure 6.—*Distribution of residential fuelwood production by source of material, Indiana, 1996.*

- Purchased wood was most frequently delivered in cords of stove-length wood (table 10).
- On average, households that purchased fuelwood burned about four-fifths of a cord of purchased wood each in 1996.

PRODUCTION

- In 1996, 523 thousand cords of roundwood fuelwood were cut in Indiana to meet the State's residential fuelwood demands (table 11).
- More than half of this total was cut from the Northern Unit of the State.
- Four-fifths of the 1996 production was harvested from forest land sources, mainly dead trees. The remainder was cut from a variety of nonforest land sources (fig. 6).
- Four main species—oak, ash, hickory, and elm—accounted for 72 percent of the fuelwood cut; oak alone accounted for two-fifths of the total (table 12).
- Essentially all of the elm was harvested from the Northern Unit (table 13).
- Private lands supplied most (98 percent) of the fuelwood harvested in 1996 (tables 14, 15).
- In 1996, only a tenth of all fuelwood produced was cut from growing-stock portions of live timberland trees (tables 16, 17 and fig. 7). As a consequence, fuelwood removals had very little impact on the growing-stock inventory, the traditional supply source of the State's primary forest products industry.

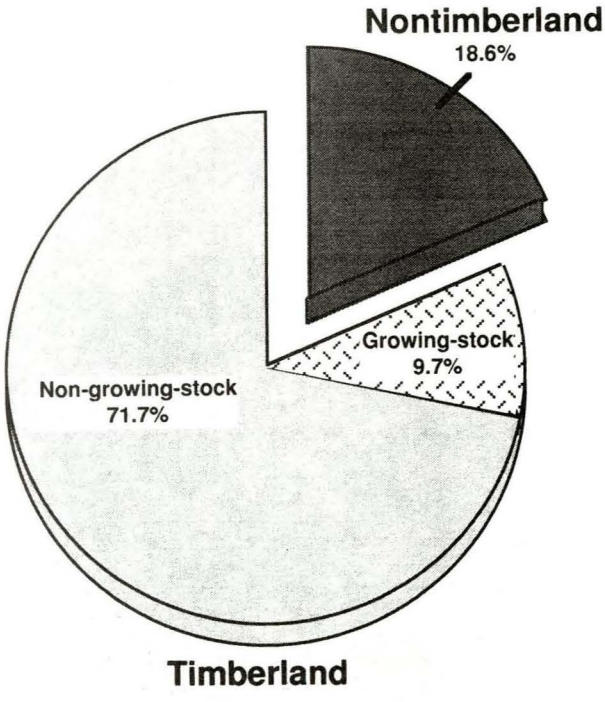

Figure 7.—*Distribution of timber removals associated with residential fuelwood production, Indiana, 1996.*

APPENDIX

STUDY METHODS

Data for this publication were collected by a telephone survey conducted during the summer of 1996 by the Indiana Department of Natural Resources and its contractors. The telephone survey sampled Indiana households and all known commercial producers, using formal questionnaires prepared by the North Central Forest Experiment Station and approved by the Federal Office of Management and Budget.

Residential Households

The sampled universe encompassed all households in Indiana with telephones. A total sample size of 1,123 households was selected based on funding available and a desired standard error of less than ± 20 percent statewide at one standard deviation. The State was stratified into two sampling strata (urban and rural) based on population densities within counties (fig. 8).

The total number of samples was disproportionally allocated to each stratum based on the number of households and the expected variation in fuelwood production in each stratum. The strata samples were proportionally distributed across the counties in each stratum based on the number of households in each county. The county samples were evenly distributed across the three-digit telephone exchanges in each county. A random list of telephone numbers was generated for each county using all listed three-digit phone exchanges. One call was placed (whether successful or unsuccessful) to each of the random telephone numbers until the necessary number of residential households within each exchange and county was contacted. In the urban stratum, about 1 in 2,326 households were sampled; in the rural stratum, about 1 in 1,350 households were sampled. Stratum sample responses were expanded to population estimates of total fuelwood use based on these sample rates.

Figure 8.—*Sampling strata in Indiana, 1996.*

Commercial Producers

A list of 128 commercial fuelwood producers was compiled by the Indiana Department of Natural Resources. These commercial producers were canvassed about their production of residential fuelwood, using a formal questionnaire similar to that used for households. Possible duplicate sampling was minimized by cross-checking telephone numbers of all sample households producing more than 10 cords of fuelwood against the commercial producers list.

Completed questionnaires were sent to the North Central Forest Experiment Station for editing and processing. Some respondents did not know the tree species cut or burned for fuel, except in general terms such as mixed hardwoods. As part of the processing, general species groupings were prorated to individual species specifically identified as being harvested or burned in a sampling stratum and Forest Survey Unit.

SAMPLING ERROR

All the reported figures are estimates based on sampling procedures that are designed to give accurate estimates of residential fuelwood consumption and production. A measure of reliability of these figures is given by sampling errors. This sampling error means that the chances are two out of three that the results for the sample differ by no more than the amount indicated from the results that would have been obtained if a complete census of all households and commercial producers had been made. Sampling errors for estimates of residential fuelwood consumption and production in Indiana are shown below:

STUDY LIMITATIONS

This study reports both the consumption and production of residential fuelwood in Indiana for a 1-year period ending at the time of the telephone survey, essentially encompassing the 1995/96 burning season, but dated 1996 for reporting purposes. Consumption refers to the volume of fuelwood burned by Indiana's wood-burning households, regardless of the source of the fuelwood (roundwood, wood residues from primary or secondary manufacturing, scrap or waste wood products, etc.). Production, on the other hand, refers only to the volume of roundwood harvested to supply Indiana's wood-burning households. Production does not include fuelwood produced from wood residues generated at primary wood-using mills (such as sawmills and veneer mills), fuelwood produced from roundwood for industrial consumption, fuelwood produced from wood residues generated at secondary wood-using mills (such as millwork plants and furniture plants), or fuelwood produced from waste wood products. However, fuelwood produced from primary mill residues and fuelwood produced for industrial consumption are captured in Indiana's timber product output studies. And although fuelwood production from secondary mill residues and waste wood products are beyond the scope of Forest Inventory and Analysis duties, part of this volume is captured in the consumption portion of the residential fuelwood studies (table 7). Due to these definition differences, as well as seasoning time, leftover fuelwood inventories from previous years, gift or free wood, interstate wood movement, and fluctuating participation in wood burning, estimates of fuelwood production and consumption should not be expected to match in a given year.

Stratum	Consumption (Cords)	Error (Percent)	Production (Cords)	Error (Percent)
Urban households	143,486	16.7	152,142	20.7
Rural households	367,703	13.9	360,988	14.0
Residential households	511,189	11.0	513,130	11.6
Commercial producers	—	—	9,534	—
State total	511,189	11.0	522,664	11.4

Households without telephones were not sampled. To compensate for this omission, sample responses from households with phones were assumed representative of the relatively small number of households without phones, and were expanded across all existing households in Indiana. Study results may be slightly biased if fuelwood consumption or production per household differs significantly in quantity or sources between phoneless households and households with phones.

To assess the impacts of fuelwood harvesting on the State's forest inventory from the telephone survey responses, reported fuelwood harvests from "woodland areas outside of city or village limits" were assumed to be the same as forest land harvests, and all forest land harvests were assumed to be timberland harvests.

DEFINITION OF TERMS

Central stem.—The portion of a tree between a 1-foot stump and the minimum 4.0-inch top diameter outside bark or the point where the central stem breaks into limbs.

Commercial producers.—Commercial fuelwood operators. Those who harvest fuelwood to sell to dealers or consumers. Includes loggers who harvest fuelwood along with saw logs and other products.

Commercial species.—Tree species presently or prospectively suitable for industrial wood products. (Note: Excludes species of typically small size, poor form, or inferior quality such as hophornbeam, Osage-orange, and redbud.)

Cord (standard fuelwood).—A pile of logs 4x4x8 feet (128 cubic feet including air space and bark). A standard cord of fuelwood contains 70 cubic feet of wood and 58 cubic feet of bark and air space.

Cull removals.—Net volume of rough and rotten trees, plus the net volume in sections of the central stem of growing-stock trees that do not meet regional merchantability standards, harvested for roundwood products.

Dead removals.—Net volume of dead trees harvested for roundwood products.

Diameter at breast height (d.b.h.).—The outside bark diameter at 4.5 feet above the forest floor on the uphill side of the tree. For determining breast height, the forest floor includes the duff layer that may be present, but does not include unincorporated woody debris that may rise above the ground line.

Forest land.—Land at least 16.7 percent stocked by forest trees of any size, or formerly having had such tree cover, and not currently developed for nonforest use. (Note: Stocking is measured by comparing specified standards with basal area and/or number of trees, age or size, and spacing.) The minimum area for classification of forest land is 1 acre. Roadside, streamside, and shelterbelt strips of timber must have a crown width of at least 120 feet to qualify as forest land. Unimproved roads and trails, streams, or other bodies of water or clearings in forest areas shall be classed as forest if less than 120 feet wide.

Fuelwood consumption.—The fuelwood burned by residential households.

Fuelwood production.—The volume of roundwood harvested to supply residential households.

Growing-stock removals.—The growing-stock volume removed from the timberland inventory by harvesting roundwood products. (Note: Includes sawtimber removals, poletimber removals, and logging residues.)

Growing-stock tree.—A live timberland tree of commercial species that meets specified standards of size, quality, and merchantability. (Note: Excludes rough, rotten, and dead trees.)

Growing-stock volume.—Net volume of growing-stock trees 5.0 inches d.b.h. and over, from 1 foot above the ground to a minimum 4.0-inch top diameter outside bark of the central stem or to the point where the central stem breaks into limbs.

Hardwoods.—Dicotyledonous trees, usually broad-leaved and deciduous.

Harvest residues.—The total net volume of unused portions of trees cut or killed by logging. (Note: Includes both logging residues and logging slash.)

Limbwood removals.—Net volume of all portions of a tree other than the central stem, (including forks, large limbs, tops, and stumps) harvested for roundwood products.

Logging residue.—The net volume of unused portions of the merchantable central stem of growing-stock trees cut or killed by logging.

Logging slash.—The net volume of unused portions of the unmerchantable (non-growing-stock) sections of trees cut or killed by logging.

Merchantable sections.—Sections of the central stem of growing-stock trees that meet either pulpwood or saw-log specifications.

Net volume.—Gross volume less deductions for rot, sweep, or other defects affecting use for roundwood products.

Noncommercial species.—Tree species of typically small size, poor form, or inferior quality that normally do not develop into trees suitable for industrial roundwood products.

Nonforest land.—Land that has never supported forests, and land formerly forested where use for timber management is precluded by development for other uses. (Note: Includes areas used for crops, improved pasture, residential areas, city parks, improved roads of any width and adjoining clearings, powerline clearings of any width, and 1- to 39.9-acre areas of water classified by the Bureau of the Census as land. If intermingled in forest areas, improved roads and nonforest strips must be more than 120 feet wide and more than 1 acre to qualify as nonforest land.)

Nonforest land removals.—Net volume of trees on nonforest lands harvested for roundwood products.

Nontimberland.—The same as nonforest land in this report.

Poletimber.—A growing-stock tree at least 5.0 inches d.b.h. but smaller than sawtimber size (9.0 inches d.b.h. for softwoods, 11.0 inches d.b.h. for hardwoods).

Poletimber removals.—Net volume in the merchantable central stem of poletimber trees harvested for roundwood products.

Primary wood-using mills.—Mills receiving roundwood or chips from roundwood for processing into primary wood products (lumber, veneer, wood pulp, etc.).

Rotten tree.—A tree that does not meet regional merchantability standards because of excessive unsound cull.

Rough tree.—A tree that does not meet regional merchantability standards because of excessive sound cull. Includes noncommercial tree species.

Roundwood.—Logs, bolts, or other round sections cut from trees (including chips from roundwood).

Sapling.—A live tree between 1.0 and 5.0 inches d.b.h.

Sapling removals.—Net volume in saplings harvested for roundwood products.

Saw-log portion.—That portion of the central stem of sawtimber trees between the stump and the saw-log top.

Saw-log top.—The point on the central stem of sawtimber trees above which a saw log cannot be produced. The minimum saw-log top is 7.0 inches diameter outside bark (d.o.b.) for softwoods and 9.0 inches d.o.b. for hardwoods.

Sawtimber removals.—The net volume in the merchantable central stem of sawtimber trees harvested for roundwood products. (Note: Includes the saw-log and upper-stem portions of sawtimber trees.)

Sawtimber tree.—A growing-stock tree containing at least a 12-foot saw log or two noncontiguous saw logs 8 feet or longer, and meeting regional specifications for freedom from defect. Softwoods must be at least 9.0 inches d.b.h. and hardwoods must be at least 11.0 inches d.b.h.

Secondary wood-using mills.—Mills receiving primary wood products for manufacture into secondary wood products (furniture, cabinets, etc.).

Softwoods.—Coniferous trees, usually evergreen, having needles or scale-like leaves.

Tree.—A woody plant usually having one or more perennial stems, a more or less definitely formed crown of foliage, and a height of at least 12 feet at maturity.

Timberland.—Forest land that is producing, or is capable of producing, in excess of 20 cubic feet per acre per year of industrial roundwood products under natural conditions, is not withdrawn from timber utilization by statute or administrative regulation, and is not associated with urban or rural development. In this report, all forest land removals were assumed to be timberland removals.

Upper stem portion.—That portion of the central stem of sawtimber trees between the saw-log top and the minimum top diameter of 4.0 inches outside bark or to the point where the central stem breaks into limbs.

Wood residues.—Includes woody material (bark, coarse, fine, etc.) generated at primary wood-using mills, woody material (sawdust, scrap, trim, wood flour, etc.) generated at secondary wood-using plants, and waste secondary wood products.

SPECIES GROUPS, COMMON AND SCIENTIFIC NAMES OF TREE SPECIES MENTIONED

SOFTWOODS

Cedar
- Eastern redcedar ..... *Juniperus virginiana*

Pine
- Jack pine ..... *Pinus banksiana*
- Shortleaf pine ..... *Pinus echinata*
- Red pine ..... *Pinus resinosa*
- White pine ..... *Pinus strobus*
- Scotch pine ..... *Pinus sylvestris*
- Virginia pine ..... *Pinus virginiana*

HARDWOODS

Apple ..... *Malus* spp.

Ash
- White ash ..... *Fraxinus americana*
- Black ash ..... *Fraxinus nigra*
- Green ash ..... *Fraxinus pennsylvanica*
- Blue ash ..... *Fraxinus quadrangulata*

Beech ..... *Fagus grandifolia*

Birch
- Yellow birch ..... *Betula alleghaniensis*
- River birch ..... *Betula nigra*
- Paper birch ..... *Betula papyrifera*

Boxelder ..... *Acer negundo*

Catalpa
- Northern catalpa ..... *Catalpa speciosa*

Cherry
- Black cherry ..... *Prunus serotina*
- Choke cherry ..... *Prunus virginiana*

Cottonwood
- Eastern cottonwood ..... *Populus deltoides*

Elm
- Winged elm ..... *Ulmus alata*
- American elm ..... *Ulmus americana*
- Siberian elm ..... *Ulmus pumila*
- Slippery elm ..... *Ulmus rubra*
- Rock elm ..... *Ulmus thomasii*

Hackberry ..... *Celtis occidentalis*

Hickory
- Bitternut hickory ..... *Carya cordiformis*
- Pignut hickory ..... *Carya glabra*
- Shellbark hickory ..... *Carya lacinosa*
- Shagbark hickory ..... *Carya ovata*
- Mockernut hickory ..... *Carya tomentosa*

Locust
- Honeylocust ..... *Gleditsia triacanthos*
- Black locust ..... *Robinia pseudoacacia*

Maple
- Black maple ..... *Acer nigrum*
- Red maple ..... *Acer rubrum*
- Silver maple ..... *Acer saccharinum*
- Sugar maple ..... *Acer saccharum*

Mulberry
- White mulberry ..... *Morus alba*
- Red mulberry ..... *Morus rubra*

Oak
- Red oak
  - Scarlet oak ..... *Quercus coccinea*
  - Northern pin oak ..... *Quercus ellipsoidalis*
  - Southern red oak ..... *Quercus falcata*
  - Cherrybark oak ..... *Quercus falcata* var. *pagodifolia*
  - Shingle oak ..... *Quercus imbricaria*
  - Blackjack oak ..... *Quercus marilandica*
  - Pin oak ..... *Quercus palustris*
  - Northern red oak ..... *Quercus rubra*
  - Shumard oak ..... *Quercus shumardii*
  - Black oak ..... *Quercus velutina*
- White oak
  - White oak ..... *Quercus alba*
  - Swamp white oak ..... *Quercus bicolor*
  - Overcup oak ..... *Quercus lyrata*
  - Bur oak ..... *Quercus macrocarpa*
  - Swamp chestnut oak ..... *Quercus michauxii*
  - Chinkapin oak ..... *Quercus muehlenbergii*
  - Chestnut oak ..... *Quercus prinus*
  - Post oak ..... *Quercus stellata*

Pecan ..... *Carya illinoensis*

Sassafras ..... *Sassafras albidum*

Smoketree ..... *Cotinus obovatus*

Walnut
Black walnut ..... *Juglans nigra*
Willow
Black willow ..... *Salix nigra*
Yellow poplar ..... *Liriodendron tulipifera*

TABLE TITLES

Table 1.—Household possession and use of wood-burning facilities by Forest Survey Unit, Indiana, 1996

Table 2.—Residential fuelwood consumption by Forest Survey Unit and reason for burning, Indiana, 1996

Table 3.—Residential fuelwood consumption by Forest Survey Unit and wood-burning facility, Indiana, 1996

Table 4.—Residential fuelwood consumption by wood-burning facility and reason for burning, Indiana, 1996

Table 5.—Residential fuelwood consumption by reason for burning and year first burned wood, Indiana, 1996

Table 6.—Residential fuelwood consumption by Forest Survey Unit and place of consumption, Indiana, 1996

Table 7.—Residential fuelwood consumption by Forest Survey Unit and type of fuelwood, Indiana, 1996

Table 8.—Residential fuelwood consumption by species group and Forest Survey Unit, Indiana, 1996

Table 9.—Residential fuelwood consumption by Forest Survey Unit and procurement method, Indiana, 1996

Table 10.—Residential consumption of purchased fuelwood by size of wood, Indiana, 1996

Table 11.—Residential fuelwood production from roundwood by Forest Survey Unit and source of material, Indiana, 1996

Table 12.—Residential fuelwood production from roundwood by species group and source of material, Indiana, 1996

Table 13.—Residential fuelwood production from roundwood by species group and Forest Survey Unit, Indiana, 1996

Table 14.—Residential fuelwood production from roundwood by species group and ownership class, Indiana, 1996

Table 15.—Residential fuelwood production from roundwood by ownership class and source of material, Indiana, 1996

Table 16.—Distribution of timber removals associated with residential fuelwood production by Forest Survey Unit, Indiana, 1996

Table 17.—Distribution of timber removals associated with residential fuelwood production by species group, Indiana, 1996

Table 1. -- Household possession and use of wood-burning facilities by Forest Survey Unit, Indiana, 1996

(In number of households)

Forest Survey Unit	Households	Households with wood-burning facilities	Households burning wood in 1996	Households planning to burn wood in 1997	Households planning to install wood-burning facilities
Lower Wabash	213,444	61,279	24,523	32,851	12,750
Knobs	238,491	90,970	69,892	67,939	1,350
Upland Flats	65,644	21,593	18,894	18,894	2,699
Northern	1,547,776	429,253	288,974	275,763	39,686
Total	2,065,355	603,095	402,283	395,447	56,485

Table 2. -- Residential fuelwood consumption by Forest Survey Unit and reason for burning, Indiana, 1996

Forest Survey Unit and reason for burning	Number of households	Volume (Cords)	Average (Cords/ household)
Lower Wabash			
Pleasure	11,027	2,831	0.26
Primary heat	4,049	41,271	10.19
Secondary heat	9,447	13,552	1.43
Total	24,523	57,653	2.35
Knobs			
Pleasure	20,474	4,482	0.22
Primary heat	16,195	80,079	4.94
Secondary heat	33,224	61,314	1.85
Total	69,892	145,875	2.09
Upland Flats			
Pleasure	4,049	2,915	0.72
Primary heat	6,748	37,787	5.60
Secondary heat	8,097	13,507	1.67
Total	18,894	54,209	2.87
Northern			
Pleasure	180,284	65,956	0.37
Primary heat	24,523	81,106	3.31
Secondary heat	84,167	106,389	1.26
Total	288,974	253,451	0.88
All Units			
Pleasure	215,834	76,184	0.35
Primary heat	51,514	240,243	4.66
Secondary heat	134,935	194,762	1.44
Total	402,283	511,189	1.27

Table 3. -- Residential fuelwood consumption by Forest Survey Unit and wood-burning facility, Indiana, 1996

Forest Survey Unit and wood-burning facility	Number of households	Volume (Cords)	Average (Cords/ household)
Lower Wabash			
Stove	10,423	22,990	2.21
Furnace	1,350	26,993	20.00
Fireplace insert	1,350	2,699	2.00
Fireplace	6,375	3,172	0.50
Fire pit	3,676	1,179	0.32
Combinations	1,350	621	0.46
Total	24,523	57,653	2.35
Knobs			
Stove	26,849	70,759	2.64
Furnace	9,074	34,369	3.79
Fireplace insert	8,097	17,669	2.18
Fireplace	20,474	6,763	0.33
Combinations	5,398	16,315	3.02
Total	69,892	145,875	2.09
Upland Flats			
Stove	8,097	25,311	3.13
Furnace	1,350	10,797	8.00
Fireplace insert	1,350	450	0.33
Fireplace	4,049	2,915	0.72
Combinations	4,049	14,737	3.64
Total	18,894	54,209	2.87
Northern			
Stove	53,324	93,169	1.75
Furnace	11,773	46,587	3.96
Fireplace insert	15,306	18,045	1.18
Fireplace	173,909	65,774	0.38
Fire pit	25,960	8,062	0.31
Combinations	8,701	21,814	2.51
Total	288,974	253,451	0.88
All Units			
Stove	98,694	212,228	2.15
Furnace	23,546	118,746	5.04
Fireplace insert	26,103	38,863	1.49
Fireplace	204,807	78,624	0.38
Fire pit	29,636	9,241	0.31
Combinations	19,497	53,487	2.74
Total	402,283	511,189	1.27

Table 4. -- Residential fuelwood consumption by wood-burning facility and reason for burning, Indiana, 1996

Wood-burning facility	All reasons		Reason for burning					
			Pleasure		Primary heat		Secondary heat	
	Number of households	Volume (Cords)	Number of households	Volume (Cords)	Number of households	Volume (Cords)	Number of households	Volume (Cords)
Stove	98,694	212,228	11,027	5,739	26,618	97,322	61,049	109,168
Furnace	23,546	118,746	2,326	775	13,123	99,846	8,097	18,124
Fireplace insert	26,103	38,863	5,025	3,028	1,350	5,848	19,728	29,988
Fireplace	204,807	78,624	162,794	55,263	2,326	3,489	39,686	19,872
Fire pit	29,636	9,241	29,636	9,241	--	--	--	--
Combinations	19,497	53,487	5,025	2,138	8,097	33,738	6,375	17,610
Total	402,283	511,189	215,834	76,184	51,514	240,243	134,935	194,762

Table 5. -- Residential fuelwood consumption by reason for burning and year first burned wood, Indiana, 1996

Reason for burning and year first burned wood	Number of households	Volume (Cords)	Average (Cords/ household)
Pleasure			
Last year	35,638	15,549	0.44
2 years ago	20,935	6,039	0.29
3 years ago	27,310	8,944	0.33
4 years ago	11,027	4,742	0.43
5 or more years ago	120,924	40,910	0.34
Total	215,834	76,184	0.35
Primary heat			
2 years ago	4,652	12,445	2.68
3 years ago	1,350	11,245	8.33
5 or more years ago	45,512	216,553	4.76
Total	51,514	240,243	4.66
Secondary heat			
Last year	9,677	4,443	0.46
2 years ago	7,351	5,629	0.77
3 years ago	12,377	12,939	1.05
4 years ago	10,050	6,857	0.68
5 or more years ago	95,479	164,894	1.73
Total	134,935	194,762	1.44
All reasons			
Last year	45,315	19,992	0.44
2 years ago	32,939	24,113	0.73
3 years ago	41,036	33,128	0.81
4 years ago	21,077	11,599	0.55
5 or more years ago	261,916	422,357	1.61
Total	402,283	511,189	1.27

Table 6. -- Residential fuelwood consumption by Forest Survey Unit and place of consumption, Indiana, 1996

Forest Survey Unit and place of consumption	Number of households	Volume consumed					Average (Cords/ household)
		Primary residence (Cords)	Secondary residence (Cords)	Other building (Cords)	Other[1] (Cords)	Total consumption (Cords)	
Lower Wabash							
Primary residence	23,173	57,033	--	--	--	57,033	2.46
Other[1]	1,350	--	--	--	621	621	0.46
Total	24,523	57,033	--	--	621	57,653	2.35
Knobs							
Primary residence	63,890	141,960	--	--	--	141,960	2.22
Secondary residence	2,326	--	775	--	--	775	0.33
Other building	3,676	--	--	3,141	--	3,141	0.85
Total	69,892	141,960	775	3,141	--	145,875	2.09
Upland Flats							
Primary residence	18,894	54,209	--	--	--	54,209	2.87
Total	18,894	54,209	--	--	--	54,209	2.87
Northern							
Primary residence	262,641	234,227	--	--	--	234,227	0.89
Other building	7,351	--	--	6,468	--	6,468	0.88
Other[1]	17,632	--	--	--	3,444	3,444	0.20
Combination	1,350	8,381	--	931	--	9,312	6.90
Total	288,974	242,608	--	7,399	3,444	253,451	0.88
All Units							
Primary residence	368,598	487,428	--	--	--	487,428	1.32
Secondary residence	2,326	--	775	--	--	775	0.33
Other building	11,027	--	--	9,608	--	9,608	0.87
Other[1]	18,982	--	--	--	4,065	4,065	0.21
Combination	1,350	8,381	--	931	--	9,312	6.90
Total	402,283	495,809	775	10,539	4,065	511,189	1.27

[1] Consumed at campsites.

Table 7. -- Residential fuelwood consumption by Forest Survey Unit and type of fuelwood, Indiana, 1996

Forest Survey Unit and type of fuelwood	Number of households	Volume consumed			Average (Cords/ household)
		Roundwood (Cords)	Wood residues (Cords)	Total consumption (Cords)	
Lower Wabash					
Roundwood	23,173	56,358	--	56,358	2.43
Wood residues	1,350	--	1,296	1,296	0.96
Total	24,523	56,358	1,296	57,653	2.35
Knobs					
Roundwood	62,541	135,523	--	135,523	2.17
Wood residues	2,326	--	15	15	0.01
Combination	5,025	5,529	4,809	10,337	2.06
Total	69,892	141,051	4,824	145,875	2.09
Upland Flats					
Roundwood	14,845	48,602	--	48,602	3.27
Wood residues	1,350	--	2,699	2,699	2.00
Combination	2,699	1,724	1,184	2,908	1.08
Total	18,894	50,326	3,883	54,209	2.87
Northern					
Roundwood	256,639	244,954	--	244,954	0.95
Wood residues	22,658	--	2,193	2,193	0.10
Combination	9,677	2,555	3,749	6,304	0.65
Total	288,974	247,509	5,942	253,451	0.88
All Units					
Roundwood	357,198	485,437	--	485,437	1.36
Wood residues	27,683	--	6,203	6,203	0.22
Combination	17,402	9,807	9,742	19,550	1.12
Total	402,283	495,244	15,945	511,189	1.27

Table 8. -- Residential fuelwood consumption by species group and Forest Survey Unit, Indiana, 1996

(In cords)

Species group	All Units	Forest Survey Unit			
		Lower Wabash	Knobs	Upland Flats	Northern
Softwoods					
Cedar	3,599	--	--	124	3,475
Pine	3,183	--	--	1,350	1,833
Total softwoods	6,782	--	--	1,474	5,308
Hardwoods					
Maple	38,079	319	1,858	--	35,901
Boxelder	1,775	--	--	--	1,775
Hickory	64,203	2,108	44,490	3,348	14,256
Catalpa	133	--	--	--	133
Hackberry	1,704	--	--	--	1,704
Beech	4,835	319	4,516	--	--
Ash	83,331	21,900	20,540	12,975	27,917
Locust	14,336	--	--	9,626	4,709
Walnut	8,568	--	605	--	7,964
Yellow poplar	1,844	319	1,525	--	--
Apple	321	--	--	--	321
Mulberry	3,551	--	--	--	3,551
Cottonwood	2,219	--	--	--	2,219
Cherry	16,449	5,264	--	--	11,185
Oak	207,777	27,423	70,772	26,786	82,796
Willow	148	--	--	--	148
Sassafras	20,165	--	1,570	--	18,594
Elm	34,969	--	--	--	34,969
Total hardwoods	504,407	57,653	145,875	52,736	248,143
All species	511,189	57,653	145,875	54,209	253,451

Table 9. -- Residential fuelwood consumption by Forest Survey Unit and procurement method, Indiana, 1996

Forest Survey Unit and procurement method	Number of households	Volume purchased (Cords)	Volume cut (Cords)	Volume other[1] (Cords)	Total consumption (Cords)	Average (Cords/ household)
Lower Wabash						
Buy[1]	5,025	3,008	--	--	3,008	0.60
Cut	18,148	--	53,087	--	53,087	2.93
Cut and buy[1]	1,350	779	779	--	1,559	1.16
Total	24,523	3,787	53,866	--	57,653	2.35
Knobs						
Buy[1]	20,847	40,449	--	2,024	42,474	2.04
Cut	33,970	--	73,904	--	73,904	2.18
Cut and buy[1]	15,076	13,296	12,952	3,250	29,498	1.96
Total	69,892	53,745	86,856	5,274	145,875	2.09
Upland Flats						
Buy[1]	6,748	15,295	--	1,242	16,537	2.45
Cut	9,447	--	34,764	--	34,764	3.68
Cut and buy[1]	2,699	405	1,334	1,169	2,908	1.08
Total	18,894	15,700	36,099	2,411	54,209	2.87
Northern						
Buy[1]	113,661	34,653	--	15,338	49,992	0.44
Cut	133,301	--	165,097	--	165,097	1.24
Cut and buy[1]	42,012	10,473	22,624	5,265	38,362	0.91
Total	288,974	45,126	187,721	20,604	253,451	0.88
All Units						
Buy[1]	146,281	93,406	--	18,604	112,010	0.77
Cut	194,865	--	326,852	--	326,852	1.68
Cut and buy[1]	61,137	24,953	37,690	9,684	72,327	1.18
Total	402,283	118,359	364,542	28,288	511,189	1.27

[1] Includes gift wood, free wood, leftover wood, etc.

Table 10. -- Residential consumption of purchased fuelwood by size of wood, Indiana, 1996

Size of wood purchased	Number of households	Volume (Cords)	Average (Cords/ household)
16 inch	107,341	101,057	0.94
24 inch	6,375	9,682	1.52
4 foot	2,326	775	0.33
Random length residues	27,683	6,263	0.23
Random length roundwood	2,326	582	0.25
Total	146,050	118,359	0.81

Table 11. -- Residential fuelwood production from roundwood by Forest Survey Unit and source of material, Indiana, 1996

(In cords)

Forest Survey Unit	All sources	Source of material				
				Forest land		
		Cities and villages	Windbreaks, fencerows, rural yards	Standing live trees	Harvest residues	Dead trees
Lower Wabash	76,875	386	8,912	12,149	2,800	52,628
Knobs	109,980	871	20,153	13,577	15,002	60,378
Upland Flats	59,015	--	3,421	18,449	3,380	33,766
Northern	276,794	32,765	30,662	18,719	24,727	169,921
Total	522,664	34,022	63,148	62,894	45,909	316,692

Table 12. -- Residential fuelwood production from roundwood by species group and source of material, Indiana, 1996

(In cords)

Species group	All sources	Source of material				
				Forest land		
		Cities and villages	Windbreaks, fencerows, rural yards	Standing live trees	Harvest residues	Dead trees
Softwoods						
Cedar	1,490	173	260	130	140	786
Pine	6,687	3,113	139	258	270	2,908
Total softwoods	8,178	3,286	398	388	411	3,694
Hardwoods						
Maple	29,934	5,992	6,305	2,287	8,366	6,984
Boxelder	2,012	30	32	1,236	43	671
Birch	8,144	76	569	--	--	7,500
Hickory	50,719	4,016	2,955	5,890	1,364	36,493
Pecan	448	53	396	--	--	--
Hackberry	1,297	152	1,145	--	--	--
Beech	6,452	28	1,064	1,241	542	3,576
Ash	60,184	401	4,356	12,370	5,048	38,007
Locust	16,752	598	236	8,756	--	7,162
Walnut	6,264	595	235	1,559	583	3,291
Yellow poplar	12,557	104	3,991	--	1,085	7,377
Apple	2,838	57	432	2,079	--	270
Mulberry	6,881	121	910	5,851	--	--
Cottonwood	2,056	4	122	1,263	21	646
Cherry	20,613	1,992	3,660	3,872	--	11,089
Oak	219,816	10,377	30,217	13,852	28,446	136,924
Willow	2,486	1,782	704	--	--	--
Sassafras	17,490	--	--	2,235	--	15,255
Elm	47,415	4,266	5,384	13	--	37,752
Smoketree	128	92	36	--	--	--
Total hardwoods	514,487	30,735	62,750	62,506	45,498	312,998
All species	522,664	34,022	63,148	62,894	45,909	316,692

Table 13. -- Residential fuelwood production from roundwood by species group and Forest Survey Unit, Indiana, 1996

(In cords)

Species group	All Units	Forest Survey Unit			
		Lower Wabash	Knobs	Upland Flats	Northern
Softwoods					
Cedar	1,490	309	876	305	1
Pine	6,687	--	25	2	6,661
Total softwoods	8,178	309	901	306	6,661
Hardwoods					
Maple	29,934	1,763	834	1,180	26,157
Boxelder	2,012	--	3	--	2,009
Birch	8,144	--	--	--	8,144
Hickory	50,719	8,321	21,993	7,986	12,419
Pecan	448	--	--	--	448
Hackberry	1,297	--	--	--	1,297
Beech	6,452	942	3,930	782	798
Ash	60,184	17,839	11,226	15,974	15,145
Locust	16,752	1,957	3,164	8,178	3,453
Walnut	6,264	491	136	127	5,510
Yellow poplar	12,557	967	4,533	1,147	5,910
Apple	2,838	--	--	--	2,838
Mulberry	6,881	293	783	3,580	2,226
Cottonwood	2,056	12	31	1	2,012
Cherry	20,613	2,650	1,124	1,481	15,358
Oak	219,816	37,910	60,689	17,675	103,542
Willow	2,486	--	--	--	2,486
Sassafras	17,490	3,419	630	597	12,843
Elm	47,415	2	3	*	47,409
Smoketree	128	--	--	--	128
Total hardwoods	514,487	76,566	109,079	58,709	270,133
All species	522,664	76,875	109,980	59,015	276,794

* Less than 1/2 cord.

Table 14. -- Residential fuelwood production from roundwood by species group and ownership class, Indiana, 1996

(In cords)

Species group	All ownerships	Ownership class		
		State	County/ municipal	Other private
Softwoods				
Cedar	1,490	--	--	1,490
Pine	6,687	--	--	6,687
Total softwoods	8,178	--	--	8,178
Hardwoods				
Maple	29,934	41	36	29,857
Boxelder	2,012	2	1	2,009
Birch	8,144	23	13	8,108
Hickory	50,719	18	18	50,683
Pecan	448	--	1	448
Hackberry	1,297	--	2	1,295
Beech	6,452	1	*	6,451
Ash	60,184	1,099	19	59,067
Locust	16,752	3	3	16,747
Walnut	6,264	8	5	6,251
Yellow poplar	12,557	38	20	12,499
Apple	2,838	1	1	2,836
Mulberry	6,881	--	1	6,880
Cottonwood	2,056	2	2	2,053
Cherry	20,613	586	391	19,635
Oak	219,816	4,686	3,125	212,005
Willow	2,486	--	3	2,483
Sassafras	17,490	39	21	17,429
Elm	47,415	115	77	47,222
Smoketree	128	--	*	128
Total hardwoods	514,487	6,662	3,739	504,085
All species	522,664	6,662	3,739	512,263

* Less than 1/2 cord.

Table 15. -- Residential fuelwood production from roundwood by ownership class and source of material, Indiana, 1996

(In cords)

Ownership class	All sources	Source of material				
				Forest land		
		Cities and villages	Windbreaks, fencerows, rural yards	Standing live trees	Harvest residues	Dead trees
State	6,662	--	--	--	--	6,662
County/municipal	3,739	754	1	6	--	2,979
Other private	512,263	33,268	63,147	62,888	45,909	307,051
Total	522,664	34,022	63,148	62,894	45,909	316,692

Table 16. -- Distribution of timber removals associated with residential fuelwood production by Forest Survey Unit, Indiana, 1996

(In thousand cubic feet)

	Timberland removals										
	Growing-stock removals			Non-growing-stock removals					Total timberland removals	Non-timberland removals	Total Removals
Forest Survey Unit	Sawtimber	Poletimber	Total	Limbwood	Sapling	Cull trees	Dead trees	Total			
Lower Wabash	350	240	590	327	4	122	3,689	4,141	4,730	651	5,381
Knobs	551	335	887	910	9	168	4,253	5,340	6,227	1,472	7,699
Upland Flats	520	359	878	456	5	183	2,370	3,013	3,892	239	4,131
Northern	761	447	1,209	1,440	14	334	11,939	13,727	14,936	4,440	19,376
Total	2,183	1,381	3,563	3,132	31	807	22,251	26,221	29,785	6,802	36,586

Table 17. -- Distribution of timber removals associated with residential fuelwood production by species group, Indiana, 1996

(In thousand cubic feet)

Species group	Timberland removals								Total timberland removals	Non-timberland removals	Total Removals
	Growing-stock removals			Non-growing-stock removals							
	Sawtimber	Poletimber	Total	Limbwood	Sapling	Cull trees	Dead trees	Total			
Softwoods											
Cedar	5	3	8	9	*	2	55	66	74	30	104
Pine	10	6	17	17	*	3	204	224	241	228	468
Total softwoods	16	9	25	25	*	5	259	290	315	258	572
Hardwoods											
Maple	172	90	261	421	4	44	504	973	1,235	861	2,095
Boxelder	32	23	55	22	*	12	47	81	136	4	141
Birch	--	--	--	--	--	--	525	525	525	45	570
Hickory	170	116	286	159	2	59	2,557	2,776	3,062	488	3,550
Pecan	--	--	--	--	--	--	--	--	--	31	31
Hackberry	--	--	--	--	--	--	--	--	--	91	91
Beech	39	26	65	45	*	13	251	310	375	76	452
Ash	386	256	642	433	4	130	2,670	3,237	3,880	333	4,213
Locust	225	161	386	143	2	82	501	728	1,114	58	1,173
Walnut	48	32	80	52	1	16	231	300	380	58	439
Yellow poplar	15	6	21	50	*	3	518	572	592	287	879
Apple	--	--	--	34	*	111	19	164	164	34	199
Mulberry	150	108	258	95	1	55	--	152	410	72	482
Cottonwood	33	23	56	22	*	12	45	79	135	9	144
Cherry	100	71	171	63	1	36	776	877	1,047	396	1,443
Oak	740	417	1,157	1,531	14	207	9,636	11,388	12,546	2,842	15,387
Willow	--	--	--	--	--	--	--	--	--	174	174
Sassafras	57	41	99	36	*	21	1,068	1,126	1,224	--	1,224
Elm	*	*	1	*	*	*	2,643	2,643	2,644	676	3,319
Smoketree	--	--	--	--	--	--	--	--	--	9	9
Total hardwoods	2,167	1,371	3,538	3,107	31	802	21,992	25,932	29,470	6,544	36,014
All species	2,183	1,381	3,563	3,132	31	807	22,251	26,221	29,785	6,802	36,586

* Less than 1/2 cord.

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May, Dennis M.; Settle, Jeff; Benjamin, Tamara.
1997. **Residential fuelwood consumption and production in Indiana, 1996**. Resour. Bull. NC-188. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station. 29 p.

Reports findings of the latest survey of residential fuelwood consumption and production in Indiana. Topics examined include the geographic distribution of residential fuelwood consumption and production within the State; the species of trees used for residential fuelwood; the types of wood-burning facilities used; the reasons for burning fuelwood; and the land, ownership, and tree classes from which fuelwood was produced.

KEY WORDS: Fireplace, firewood, harvest, households, roundwood, wood stove.

Our job at the North Central Forest Experiment Station is discovering and creating new knowledge and technology in the field of natural resources and conveying this information to the people who can use it. As a new generation of forests emerges in our region, managers are confronted with two unique challenges: (1) Dealing with the great diversity in composition, quality, and ownership of the forests, and (2) Reconciling the conflicting demands of the people who use them. Helping the forest manager meet these challenges while protecting the environment is what research at North Central is all about.